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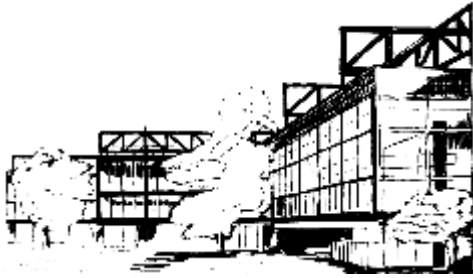
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Mobile Termination Carrier Selection

Jörn Kruse

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1 Introduction

Mobile telephony has been an ongoing success story ever since the GSM standard was introduced and competing mobile network operators were licensed beginning in the early 1990s. This success is owed largely to the fact that most European countries feature three or four mobile network operators (and additional service providers) offering their services. Most mobile markets are highly competitive. As a consequence, prices have dropped and the mobile penetration rate in most countries has proven to be very high.

It is worth noting that, as opposed to most other network industries, the mobile communications sector is characterized by several parallel physical network infrastructures, including base stations, transmission lines, switching units (MSC), etc.. Most European countries feature three or four parallel GSM infrastructures operating competitively. Basically, the countries' prevalent mobile market structures are the result of licensing policies by national regulatory authorities that assigned the GSM spectrum. The authorities required the licensees to operate as vertically integrated entities. The licensees were thereby instructed to establish individual cellular infrastructures in addition to offering their mobile services to customers.

Despite the sector's overall competitiveness and remarkable market performance, regulatory authorities have identified the wholesale submarket of mobile termination as being monopolistic. In an attempt to remedy the adverse implications, most European countries have applied an ex ante regulation. It is doubtful whether price regulation can serve as an appropriate response to the perceived termination monopoly. Nevertheless, this will not be discussed in this paper.¹ Regulation, however, is faced with severe methodological problems associated with large common costs and demand complementarities.²

¹ See for example GANS, Joshua S. and Stephen P. KING (2000): Mobile Network Competition, Customer Ignorance and Fixed-to-Mobile Call Prices, *Information Economics and Policy* 12, p. 301-327; KRUSE, Jörn (2003), Regulierung der Terminierungsentgelte der deutschen Mobilfunknetze?, in: *Wirtschaftsdienst* (March), p. 203-209; CRANDALL, Robert W. and J. Gregory SIDAK (2004), Should Regulators Set Rates to Terminate Calls on Mobile Networks?, in: *Yale Journal on Regulation*, Vol. 21., p. 1-46.

² See COMPETITION COMMISSION (2002), Vodafone, O2, Orange and T-Mobile: Reports on References under section 13 of the telecommunications act 1984 on the charges made by Vodafone, O2,

This paper focuses on the currently regulated mobile termination markets. In particular, alternative modes of transaction will be discussed in the following sections. It is important to note that the mobile termination monopoly is basically a result of previous governmental and/or regulatory decisions. This refers to standards and regulations before and during GSM implementation and licensing. It reveals that during standardization, licensing, and regulation, the authorities failed to formulate an economic analysis that would have allowed competition to prevail in all transaction segments of mobile telephony. As a consequence, specific transaction schemes and market structures have emerged, which, in turn, have led to the current problems. These transaction relations in the mobile sector will be described in further detail in the following section 2.

A fundamental message of this paper is that regulatory authorities should focus on changing the specific transaction scheme, thereby introducing competition to the termination segment, rather than regulating prices. Two economic alternatives are available to deal with the mobile termination problem. Since the conventional calling-party-pays principle is often regarded as the root cause of the termination problem, the alternative receiving-party-pays principle (section 3) has been suggested as a possible remedy.

This paper then goes on to identify another element of GSM as being the most crucial factor leading to the termination problem: The exclusive relationship between any specific handset and only a single cellular network carrying out the termination service. It is suggested in section 4 that this should be replaced by the mobile termination carrier selection principle, whereby any handset may communicate with a variety of different GSM networks. Section 5 deals with mobile termination carrier selection at both the retail and wholesale level in more detail, and section 6 goes on to mention potential merits and problems associated with this approach.

2 Calling-Party-Pays

When the cellular mobile telephony standard, GSM, was standardized and introduced by European regulatory agencies, all the basic elements of the transaction scheme had already been determined and, as a consequence, the course of the retail and wholesale market structures had been set.

Almost all European countries voted for the calling-party-pays-principle (CPP) which is nowadays considered to be responsible for the termination problems addressed here. The respective transaction relations are depicted in figure 1. Let's assume the calling party A_O , either from a fixed network or from a mobile network (both denoted as origination network O_A), calls a mobile handset B_B (receiving party) subscribed to a mobile network B.

In technical terms, the originating network provides the first segment of the phone call (origination) from the calling party A to the interconnection point (IC) with the mobile

Orange and T-Mobile for terminating calls from fixed and mobile networks, presented to the Director of telecommunications, December 2002; VALLETTI, Tommaso M. and George HOUPIS (2005), Mobile Termination: What is the "Right" Charge?, in: Journal of Regulatory Economics, November, 28 (3), p. 235-258; NEWBERRY, D. (2004), Application of Ramsey Pricing for Regulating Mobile Call Termination Charges, in: Vodafone (eds.), Regulating Mobile Call Termination, Vodafone: London, p. 12; IRG (Independent Regulators Group) (2004), Principles of Implementation and Best Practice on the Application of Remedies in the Mobile Voice Call Termination Market, 1. April 2004.

network B which is the gateway MSC_B of the latter. From IC to the mobile device B_B of the receiving party (termination segment of the call), the service is delivered by the mobile network B.

Under CPP, the calling party A_O pays O_A for the whole call (Z_{AO}). Z denotes the payment (and the transaction relation) for the whole call, whereas Y represents the payment for the originating segment (from the calling party to the interconnection point at the gateway MSC of the mobile network), and T represents the payment for the terminating segment (from the interconnection point to the receiving device B_B). Z_{AO} denotes a market transaction between the calling party A and its network O and the payment (for the whole call) from A to O.

For the termination segment of the call there is a market transaction T_{OM} in which originating network O_A pays the mobile network B. In the conventional view, B has a monopoly over the termination service under CPP, since, under the given setting, network B is solely capable of communicating with Handset B_B .

Certain reform approaches believe the main problem to lie in the CPP principle itself (see section 3), whilst another focuses on the exclusive communication patterns (see section 4).

3 Receiving party pays and Bill-and-Keep

The implementation of the calling-party-pays-principle (CPP) in most countries is seen as the main reason for the competitive problems related to mobile termination and the consequential governmental ex-ante regulation. The corresponding alternative which modifies the transaction relationships is known as the receiving-party-pays-principle (RPP) (Littlechild, 2006).

With RPP, the (fixed or mobile) calling party pays its originating network only for the first segment of the call up to the interconnection point (gateway MSC). This is represented by Y_{AO} in figure 1. The termination service from the interconnection point to the handset of B_B is charged to the receiving party B_B . If this charge T_{BM} is positive ($T_{BM} > 0$), the receiving party has to pay for incoming calls.

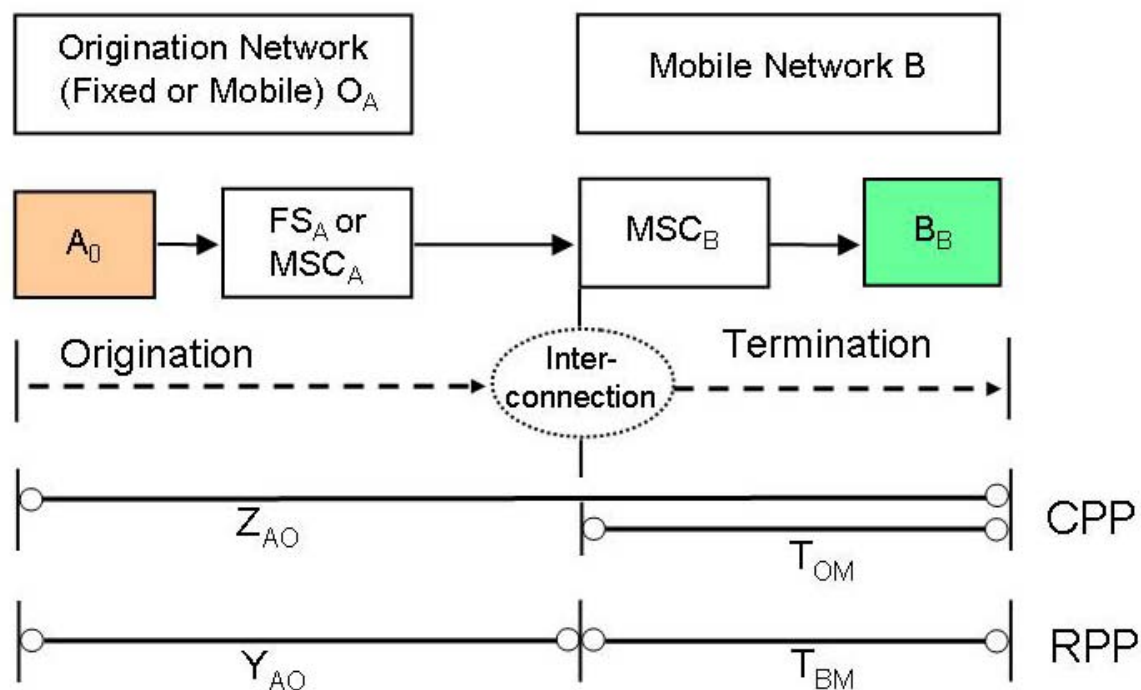
In RPP, the termination of incoming calls is a part of the service bundle a network operator provides to its subscribers. They will take the rate for the incoming calls (among the rates for other services) into account before subscribing to a specific network. Thus, mobile termination is under competitive pressure.

The pricing decision for incoming calls is up to any individual mobile network operator. Since the marginal cost of terminating a call is low, the network operator may choose not to charge his customers for incoming calls at all in order to be attractive to potential and actual subscribers. If incoming calls are not charged to the receiving party, RPP is equivalent to bill-and-keep (B&K).

Receiving-party-pays is not a new concept. A number of countries, e.g. the USA, Canada, Hong Kong and China implemented RPP, also known as Mobile-Party-Pays (MPP), from the outset. A number of other countries, especially in Latin America, initially applied RPP, but have since switched to CPP (Zehle, 2003; Dewenter/Kruse, 2006). In most European countries the RPP principle is applied to calls to mobiles roaming abroad. The calling party pays only for the national segment of the call, whereas the receiving party itself pays for the mobile service in the international segment including termination abroad. The RPP, resp. B&K, has been suggested for mobile as well as fixed networks. The discussion has been quite

controversial (Right, 2002; Quigley/Vogelsang, 2003; Crandall/Sidak, 2004; Markus, 2004; Hausmann, 2004; Littlechild, 2006).

Figure 1: Calling-Party-Pays and Receiving-Party-Pays



The main advantage of RPP as a structural alternative to CPP has already been mentioned: Since mobile termination would cease to be a monopoly, it would no longer elicit the need for regulation.

A potent argument against RPP is based on the assumption that the receiving parties might attempt to avoid payments for incoming calls by switching off their handsets altogether. This argument gains weight in the light of potentially significant numbers of commercial or other unwanted calls (junk calls).³ Even if networks opt not to charge for incoming calls, or the regulatory agency introduces bill-and-keep, junk calls might yet pose a problem, seeing as they are based on low prices for the calling party.

Switching off devices would reduce the demand for the mobile networks' airtime minutes, which, in turn, would lead to higher average costs and thus potentially higher prices. There is a concern that the penetration rate would perhaps decrease because RPP may lead to lower attractiveness of mobile telephony. There has been evidence from countries that switched from RPP to CPP that the number of incoming calls and the number of terminated mobile

³ This may be the case, even if some technical measures may be applicable, for example spam filters, different ring tones, or simply the fact that people are getting more use to looking at the display with the number of the calling party before answering the call.

minutes have increased. In general, the empirical picture with respect to CPP/RPP and penetration is not significant (Dewenter/Kruse, 2006).

There is some evidence that regulatory authorities are seriously considering introducing bill-and-keep, be it to get rid of the termination regulation problem or as a reaction to lobbying pressure from fixed networks which would have to pay less for calls to mobiles.

4 The Principle of Mobile Termination Carrier Selection

Another structural alternative to the conventional mobile termination transaction scheme is the concept of mobile termination carrier selection. This concept was first presented in Kruse/Haucap (2004) and Kruse (2006). Its application would entirely avoid the existence of a monopoly and turn the mobile termination service into an individual market that can be expected to be highly competitive.

Mobile termination carrier selection (MTCS) basically applies the conventional calling-party-pays principle. The calling party would pay for the origination as well as for the termination segment of the call. The abovementioned problems associated with receiving-party-pays would therefore be avoided.

The most fundamental technical reason for the existence of the termination monopoly (and therefore for the prevalence of governmental ex ante rate regulation) is the fact that, under the conventional setting, the subscribed mobile network is exclusively capable of communicating with the mobile device of the receiving party.

The principle of MTCS is based on the technical feasibility that terminating a call to a specific handset could also be carried out by other GSM networks offering coverage in that specific area. If this were the case, the calling party (or the originating network, respectively) would be able to choose between alternative mobile networks to terminate the call to a specific receiving device. The GSM networks would compete for delivering that service.

The proposed MTCS principle would work at the retail level as well as the wholesale level. This will be outlined in section 5. With MTCS at the retail level, the individual calling party would select the terminating network by either call-by-call or preselection. Alternatively, the origination network would select the terminating network at the wholesale level.

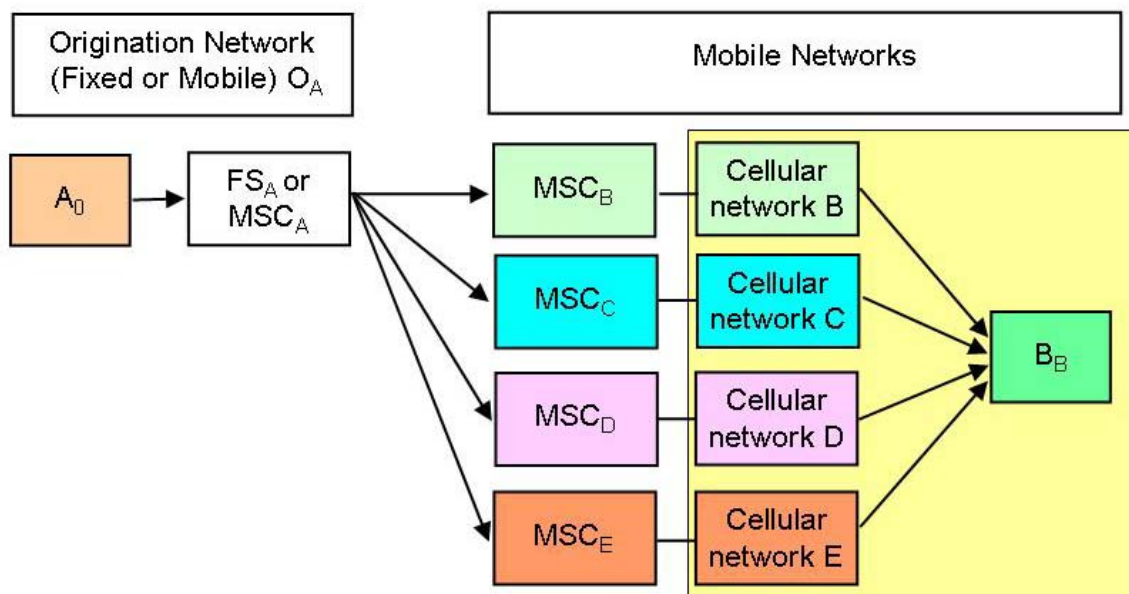
From an economic viewpoint, mobile telephony offers an important advantage over fixed-line telephony with respect to multiple infrastructures. In fixed networks, most parties are connected to the rest of the world by only a single physical subscriber line. Under these technical conditions, in order to call someone, this specific subscriber line has to be used. It can be seen as a monopoly and will therefore usually be regulated. In this respect, GSM mobile communication is completely different. Normally, three or four parallel GSM networks are in place which cover almost the entire country concerned. A specific mobile device always enjoys cellular coverage by mostly four different networks. With respect to already existing hardware, it would technically not be a problem to reach this handset.

There is, however, a software problem. The conventional GSM standard does not provide the capability of differing networks being able to reach a specific handset. This capability is exclusively reserved to the network the receiving party has subscribed to which therefore holds a monopoly. This shows that termination regulation is basically a consequence of former standardization decisions. These should be revised in such a way as to enable multiple access.

The technical setting is demonstrated in figure 2. The calling party A_O in the fixed or mobile originating network O_A wishes to call the handset B_B which is subscribed to the mobile network B. Under the conventional GSM standard, only cellular network B is able to terminate the call. Switching on handset B_B initiates the signaling traffic exclusively with network B and allows outgoing calls to be placed and incoming calls to be received solely via network B.

If the GSM standard were to be revised such that networks C, D, and E were able to gain access to handset B_B , MTCS could be introduced and all four networks would be able to compete for the service to terminate the call. This presupposes the condition that the other operators are able to receive signaling traffic from B_B in order to locate B_B in their own cellular networks at any given time and store the information in their registers.

Figure 2: Mobile Networks terminating a call to B_B



The fact that other networks' communication with a specific third party mobile device would not meet significant problems is illustrated by considering the service of international roaming. In this case, a specific GSM handset from one country roaming abroad is able to place calls in other countries where operators also use the GSM standard. Most other countries have not just one but mostly three or four GSM networks that are each capable of providing the international roaming service including termination. A technical requirement for international roaming (and for MTCS) is that both the mobile device (handset) as well as the foreign network (third network) is operating the GSM standard in the corresponding spectrum, 900 MHz or 1800 MHz.

In order to introduce MTCS, the regulatory agency would have to rule that the GSM software used by mobile operators needs to be adapted. This basically implies changing the GSM standard in such a manner as to allow different networks to conduct signaling traffic with receiving handsets.

After implementation, each individual mobile operator would then decide whether and how it wishes to supply terminating calls to handsets subscribed to other networks. Essentially, this decision would depend on the relationship between incremental costs and incremental revenues.

Incremental revenues would basically consist of the fees collected for terminating services to handsets of other cellular networks. The operators would also have incentives to prevent competing GSM networks from terminating traffic to their own subscribers by setting attractive prices. The demand side will be discussed in section 5.

The incremental costs of MTCS for a mobile operator would include the (modest) outlays for larger capacities of registers, etc. as well as operating costs which are associated with an increase in signaling traffic. Each operator would have to provide the signaling traffic of all the handsets he wishes to supply with the termination service. Whether or not capacities for payload traffic (calls to mobiles), especially base transceiver stations, mobile switching centers, transmission lines, etc. have to be scaled up basically depends on success in the mobile termination market.

Under these incremental cost and revenue conditions one can reasonably assume that every GSM operator would actively supply the termination service in the MTCS market. Thus, effective competition would be on the way. Because of competition, any price regulation of the terminating service would become completely obsolete. Under mobile termination carrier selection an individual market for the termination service would emerge.

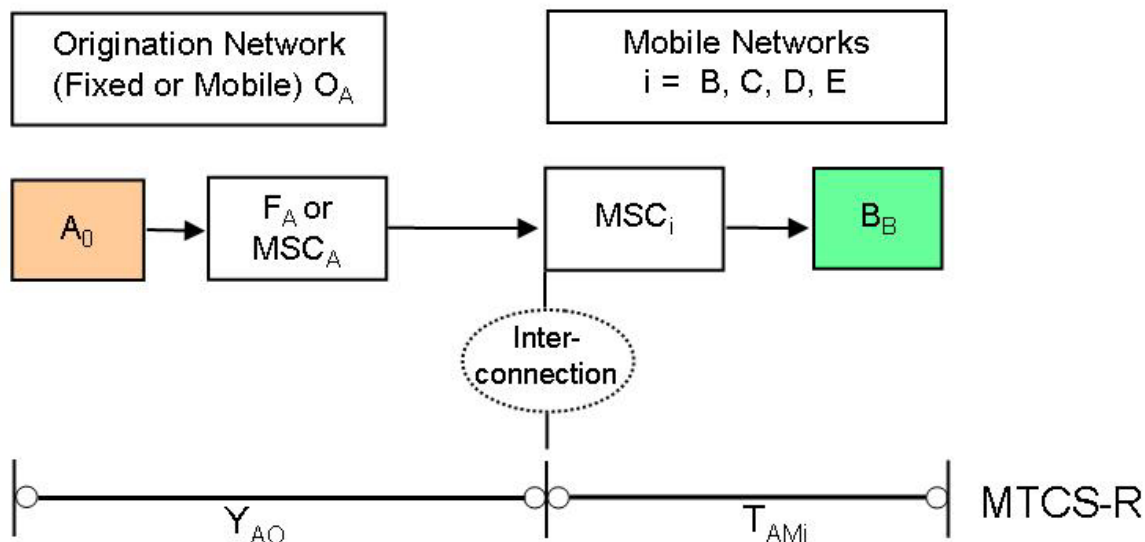
5 Mobile Termination Carrier Selection at the Retail Level and at the Wholesale Level

The markets for mobile termination carrier selection can be established at the retail level as well as at the wholesale level. The latter is based on market transactions between the terminating networks and the originating networks. Retail MTCS, on the other hand, characterizes market transactions between the individual calling parties and the terminating networks. Let's consider this variant first.

With mobile termination carrier selection at the retail level (figure 3), the individual caller (either from a fixed or from a mobile network) would select the mobile network he wishes to terminate his calls to a mobile number. In principle, this could work on a call-by-call as well as on a preselection basis. Regarding retail MTCS on a call-by-call basis, the customer would select the terminating service for each individual call. To do so, he would have to append a specific carrier code to the mobile number of the desired receiving party. In the case of retail MTCS and preselection, a calling customer would subscribe to a contract with a specific mobile network to terminate all future calls to mobiles.

In retail MTCS (call-by-call or preselection), the individual calling party would pay for the complete call to a mobile, thus covering both segments ($Y_{AO} + T_{AMi}$). A_O would therefore face two different transaction partners for both particular segments of his call. The originating network O_A would be the transaction partner for the originating segment of the call up to the interconnection point, whilst the selected mobile network would be the transaction partner in the terminating segment (from the interconnection point up to B_B). The entire billing process would be managed by the origination network which would charge the customer for both segments of the call and transfer the termination fee T_{AMi} to the selected mobile network i .

Figure 3: Mobile Termination Carrier Selection at the Retail Level



Since the calling party would pay for the mobile segment of his call (as always under CPP), he would be incentivised to select the most favorable offer, either by call-by-call or preselection. The calling party would also have an incentive to remain informed on different termination rates, thus incurring information cost.

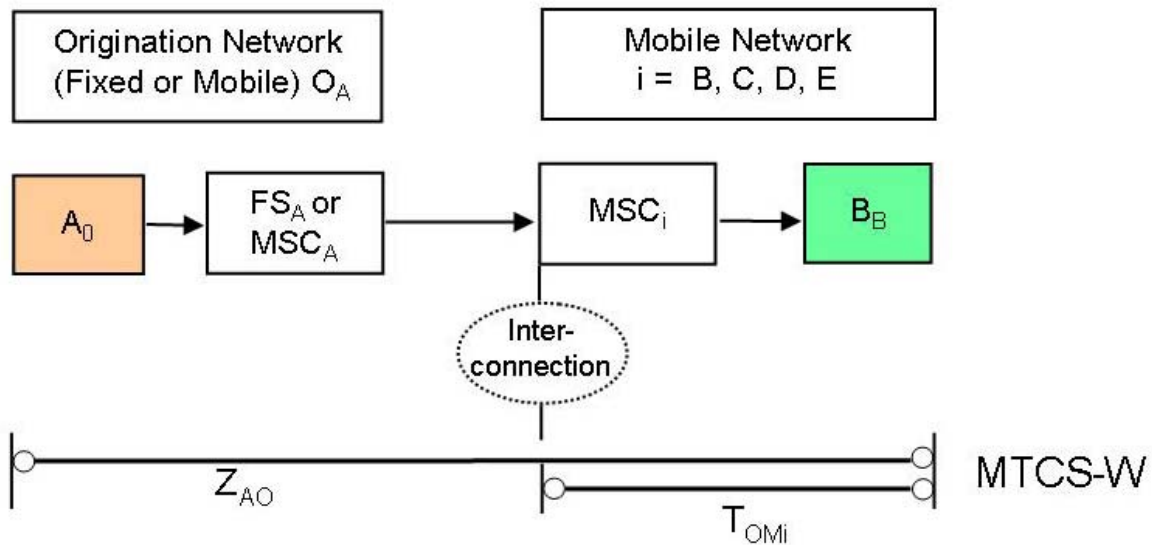
The termination service is nearly homogenous, the only relevant quality parameter being regional coverage. If the selected termination network should lack coverage in the relevant location of the receiving device, the terminating service would have to be carried out by the subscribed network or by any other carrier offering coverage.

Under retail MTCS a carrier might offer third parties terminating services (as preselection and/or call-by-call) for all fixed-to-mobile and/or mobile-to-mobile calls or only for specific market segments. In particular, mobile originating networks would have incentives to offer particularly favorable conditions to their own customers for off-net-calls (calls to mobiles subscribed to other networks). Thereby, the original off-net-calls would turn into on-net-calls.

Another transaction scheme is MTCS at the wholesale level (network level). The fixed and mobile originating networks would constitute the demand side and engage in market transactions with mobile terminating networks. Each origination network would negotiate favorable termination rates for calls to mobiles, since termination rates represent major input costs. These rates would influence their competitiveness on their own retail markets where the price for calls to mobiles is a major criterion for potential subscribers.

Figure 4 shows that the transaction scheme of MTCS at the wholesale level is similar to the conventional setting of calling-party-pays (figure 1) used in European countries today. The only, yet decisive, difference is T_{OMi} instead of T_{OM} . This represents the central element of MTCS: The originating networks would be able to choose between competing mobile termination networks.

Figure 4: Mobile Termination Carrier Selection at the Wholesale Level



Under wholesale MTCS, each mobile network would have strong incentives to offer competitive termination rates, since each originating network would buy a considerable number of terminating minutes per month. On the termination cost side, not only short run but also long run incremental cost would be low since termination uses the same network elements that are also necessary for outgoing calls.

Mobile originating networks generally have cost incentives to terminate calls to mobiles on their own network, and this is also (in economic terms) technically efficient.

The regulatory authority would not have to opt for retail or wholesale MTCS. In general, this could be left to the market. Retail MTCS and wholesale MTCS might coexist. The originating networks would (on the basis of their wholesale agreements with terminating carriers) offer their customers a tariff for all fixed-to-mobile or mobile-to-mobile calls. At the same time, mobile networks might offer preselection and/or call-by-call options to calling parties from other networks to terminate their calls.

The calling party would compare its network's prices for complete calls to mobiles Z_{AO} with the sum of the prices for the originating (Y_{AO}) and the terminating (T_{AMi}) segment. If $Y_{AO} + T_{AMi} < Z_{AO}$, the individual caller would opt for the retail option. Vice versa, he would take advantage of his network's comprehensive offer for complete calls to mobiles which would entail additional significant information and transaction cost advantages for the caller.

Presumably, in most cases $Y_{AO} + T_{AMi} > Z_{AO}$ holds because the originating networks have informational and bargaining advantages. They would probably be able to negotiate more favorable termination rates with mobile networks than their customers would receive on the retail termination market for either call-by-call or preselection ($T_{OMi} < T_{AMi}$). The originating networks would set their prices for Y_{AO} in the retail scheme as well as Z_{AO} in the wholesale scheme. Therefore, the originating networks would be able to design their price structures

such that their customers would prefer the wholesale option. They would have incentives to do so due to cost reasons (scale economies in transmission lines to MSCs) as well as for reasons of termination input prices T_{OMi} which might tend to decrease with larger volume.

Thus, the actual scale of retail and wholesale MTCS, respectively, could be left to market forces and consumer preferences. For most (if not almost all) transactions it can be expected that wholesale MTCS would prevail as has been outlined above. It would not only be technically cost efficient for the carriers but also transaction cost efficient from an economic point of view.

From a consumer perspective, the predicted outcome that the wholesale MTCS would prevail possesses the important advantage that the callers would not be required to constantly remain informed on retail termination rates, since they could rely on favorable terms of origination networks based on wholesale MTCS. Retail MTCS would then mostly function as an element securing contestability.

It might then be advisable for regulatory authorities to rule that all originating networks have to allow retail MTCS which would include offering the originating service separately and to announce the respective rate for Y_{AO} . This would hamper collusion, if it should be a problem. Generally speaking, the fact that only three or four networks exist that are capable of providing the service, one may be concerned whether mobile termination markets would actually be competitive or in fact subject to collusion. The market structure for termination services would be equivalent to that of other mobile services (subscription, outgoing calls, etc.) in which collusion is not likely to occur (Kruse, 2004) and actually does not occur. Among the reasons are high fixed and very low marginal costs, market homogeneity, vertical market transparency and high elasticity of demand, excess capacity in UMTS, etc.. Additionally, the mobile operators have quite different incentives. This is especially true with respect to the larger GSM firms that were licensed early on on the one hand, and the respective third and fourth operators aggressively vying for market shares on the one other.

6 Merits and Problems

The main advantage of MTCS is the avoidance of any mobile termination monopoly such that regulation of terminating rates would be rendered completely obsolete and could be abandoned altogether. In MTCS wholesale as well as in MTCS retail markets the mobile termination rates would be determined by network operators' decisions in competitive markets, so efficient prices could be expected to prevail.

Under MTCS the termination service would be supplied in a separate competitive market. It would not be a part of larger package as is the case under RPP. The specific problems regarding RPP which were discussed in section 3 would not appear.

If MTCS were to be implemented initially at both the retail and the wholesale level, it could be expected to develop predominantly into wholesale MTCS which is more efficient from an economic point of view. Essentially, the introduction of MTCS would maintain the conventional CPP principle, avoiding a reversal of transactional relationships between the calling and receiving parties. In this respect, the regulatory authority could therefore rest assured that consumers would not oppose the new scheme. Most of them would not even realize the change, other than perhaps paying less for calls to mobiles, depending on the pricing policy of the carriers.

Certain requirements and potential problems would be associated with the introduction of MTCS. These are discussed in the following four points.

1. The introduction of mobile termination carrier selection necessitates an explicit decision by the regulatory agencies. The authorities might hesitate for two reasons. Firstly, they prefer, whenever possible, to avoid any economic and political risk that is necessarily associated with any regulatory change. Secondly, they might not espouse the idea of abandoning termination regulation which is associated with budgets and jobs in regulatory agencies.

The introduction of MTCS could be carried out at the national level as well as at the European or global level. If international agreements could not be reached, it would not at all be a problem for a single country to implement this system on its own. Because the CPP principle would essentially be maintained, this solitary move would not result in any problems for international telecommunications traffic, being most obvious in the event that wholesale MTCS prevails.

2. As mentioned above, the GSM standard needs to be revised in order to allow other GSM networks to communicate with a specific handset. Some technical modifications in the network elements as well as in the end users' devices would also be necessary, depending on the specific technical solution that would be implemented. It would determine whether or not the technical functionalities of MTCS in the handsets can be implemented by software updates and/or simply by replacing the conventional sim cards by new ones. The network operators would have to implement some new features in the next software update, in order to support MTCS and to enable communication with every GSM handset in a specific region.

3. With MTCS, the volume of data on the active handsets, their location, the billing information, etc. that would need to be stored would be higher. More signaling traffic would be generated. The mobile networks would have to expand the capacity of specific registers and network elements. This would mostly depend on their market strategy and revenue policy.

4. A more general aspect relates to the changing of regulatory rules ex post, i.e. after licensing and after mobile operators' investments. If we interpret a license agreement as a contract between the regulatory agency and the licensed firm, a change of rules raises the question of institutional stability and regulatory credibility. From an economic viewpoint, any new regulatory intervention after major sunk investments gives rise to problems.

Generally, this would also apply in the case of regulatory introduction of MTCS, since it would represent an intervention in market and revenue structures. But this was also the case regarding ex post introduction of an ex-ante-regulation of terminating rates, just as it would be with respect to any other regulatory change such as the introduction of RPP or bill-and-keep.

Mobile termination carrier selection needs to be judged in the light of the prevalent alternative, governmental ex ante price regulation. Since the concept of MTCS transforms the regulated monopoly into a competitive market, the proposed changes would seem to be highly justified, especially considering the calling and receiving parties not having to adapt to a noticeably new framework.

7 Conclusion

Any form of governmental monopoly regulation is highly unsatisfactory for a variety of reasons. This also holds for the mobile termination market. However, contrary to the case of “real monopolistic bottlenecks”, institutional alternatives are available here that would place the mobile termination service under competitive pressure. One is the concept of receiving-party-pays or bill-and-keep in which the terminating service is only one element of a larger bundle of services offered to mobile customers. The application of this principle would imply significant changes for network operators and for users, aside from additional problems (junk calls, etc.).

The other alternative would be to apply mobile termination carrier selection, whereby the mobile termination service is transformed into an individual competitive market. Here, mobile termination carrier selection at the wholesale level would represent the most efficient form, with neither the calling nor receiving party having to adapt to new transactional schemes, due to the conventional calling-party-pays principle remaining unchanged.

Since mobile termination would represent a competitive market resembling of other mobile markets characterized by large common costs, the pricing decisions would be left to mobile operators and would depend on demand elasticities as well as firms’ market and revenue strategies. It can be assumed that efficient price structures would prevail.

From an economic perspective, mobile termination carrier selection has no significant disadvantages and can be regarded as the first choice solution for the termination problem.

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